Compliant Space Mechanisms

Completed Technology Project (2012 - 2015)

Project Introduction

OBJECTIVES The proposed research will combine the areas of compliant mechanisms and space technology. Compliant mechanisms perform their function through the elastic deflection of their members. The advantages of compliant mechanisms include increased performance, reduced or eliminated assembly, no friction or wear, fewer parts, lower cost, and lower weight. These advantages make compliant mechanisms ideally suited for space or aerospace applications, where low weight and no lubrication are essential. My research will exploit the advantages of compliant mechanisms in the areas of human safety in proximity to robots and in flexible deployable structures and mechanisms. METHODS The tasks associated with the proposed research are: (1) identify compliant mechanism replacement opportunities in mechanisms and robotics, including back-driveability, transparency, reactive surfaces, and compliant joints; (2) create fundamental compliant mechanism building blocks that can be used in a wide range of applications; and (3) demonstrate effectiveness of designs in applications. BENEFITS Under the guidance of a NASA mentor (at JPL), I will apply compliant mechanism theory to create compliant-space-mechanism designs that enable the primary benefit of significant performance gains in critical applications. In doing so, I will personally benefit in engineering experience, but so will BYU and JPL in the building of a technology relationship offering new benefits and opportunities to both. The resulting shift in mechanism design will increase robustness and simplify manufacturing, leading to reduced risk and cost in space mission planning. Coupling compliant mechanism technology with adaptive structures technology will integrate these functions in fewer components, reducing mass and cost while increasing reliability. The work proposed here not only answers some of the needs put forth in several of the Space Technology Roadmaps, but it also has the potential to apply in other areas of national interest, including rehabilitation robotics and socially assistive robotics. Concurrent research in these areas is being conducted at BYU. Further, compliant mechanisms span all size scales, providing many unique solutions to technical challenges currently being faced at the nano- and micro-scales as well.

Anticipated Benefits

The resulting shift in mechanism design will increase robustness and simplify manufacturing, leading to reduced risk and cost in space mission planning. Coupling compliant mechanism technology with adaptive structures technology will integrate these functions in fewer components, reducing mass and cost while increasing reliability. The work proposed here not only answers some of the needs put forth in several of the Space Technology Roadmaps, but it also has the potential to apply in other areas of national interest, including rehabilitation robotics and socially assistive robotics. Concurrent research in these areas is being conducted at BYU. Further, compliant mechanisms span all size scales, providing many unique solutions to technical challenges currently being faced at the nano- and micro-scales as well.

Project Image Compliant Space Mechanisms

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

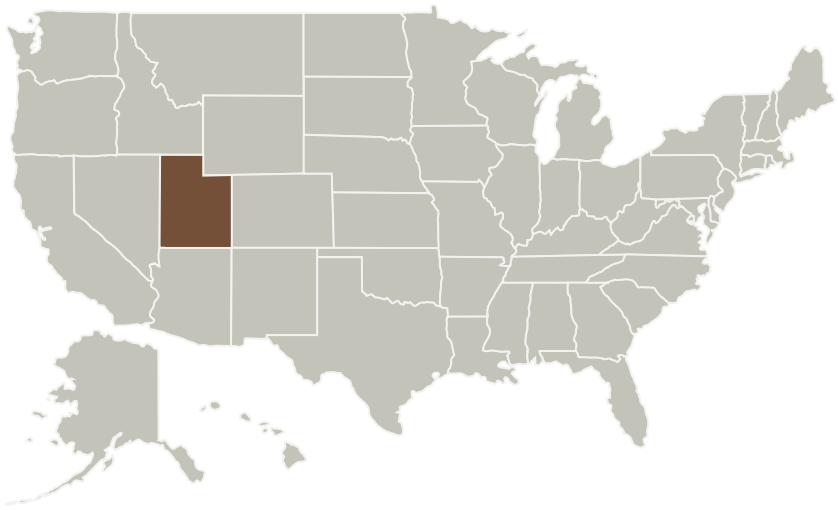
Responsible Program:

Space Technology Research Grants

Compliant Space Mechanisms

Completed Technology Project (2012 - 2015)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Brigham Young University-Provo	Supporting Organization	Academia	Provo, Utah

Primary U.S. Work Locations
Utah

Project Management

Program Director:
Claudia M Meyer

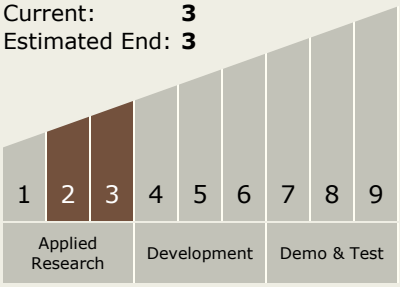
Program Manager:
Hung D Nguyen

Principal Investigator:
Larry Howell

Co-Investigator:
Shannon A Zirbel

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.3 Mechanical Systems
    - TX12.3.2 Electro-Mechanical, Mechanical, and Micromechanisms

Images

11546-1363118563395.jpg
Project Image Compliant Space Mechanisms
(https://techport.nasa.gov/image/1730)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html